COVER SHEET

Preparing preservice teachers for teaching science using English as the medium of instruction

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Abstract:
Malaysia is currently reforming its education system in line with the government's Vision 2020. This reformation is necessary to meet the needs of its own economic development and position itself in the globalisation of education. Key areas such as science and mathematics education are high on the agenda. However, as considerable world knowledge is written in English, Malaysian preservice teachers are being educated to teach these areas using English as the Medium of Instruction (EMI). Beginning 2006, the Ministry of Education Malaysia has collaborated with universities in England and Australia to devise new degrees for preparing Malaysian preservice teachers to teach science, mathematics, and design and technology using EMI. This study describes Malaysian preservice teachers' perceptions about their preparation for learning to teach science using EMI at the conclusion of their first year of a new Bachelor of Education Studies (Primary Science) degree. An open-ended questionnaire collected data from 50 Malaysian preservice teachers from a Malaysian institute. These preservice teachers indicated that English vocabulary, grammar, and pronunciation were paramount for their concept development in science education. Self assessments after one year of education also indicated an increase in English-language proficiency towards teaching primary science education (Pre course: M=4.68, SD=1.20; After one year: M=6.38, SD=1.12). Emailing, Internet chatting, short service messaging, and allocating English-only days were considered other ways for increasing such proficiencies. These and other findings are discussed in this paper to provide an understanding on practices that may be incorporated into coursework for enhancing both science education and English language skills.

Malaysia is highly motivated to strengthen its economic position in the world market, which requires developing a world-class quality education system (Rahman Idris, 2005). Attaining scientific literacy must be viewed as central to education reform (Gallagher, 2000; Pattanayak, 2003) as this is considered a way to empower citizens towards economic gain (Ayala, 2005; Jenkins, 1990). A scientifically-literate public can enhance a country's market position (Bischoff, Hatch, & Watford, 1999); however extensive science knowledge is written in English that needs to be accessed by English as Foreign Language (EFL) countries. Hence, education reform in EFL countries are beginning to target the foundational levels of learning such as primary education with specialist teachers who can focus on science education using English as the Medium of Instruction (EMI), which is the thrust of the Ninth Malaysia Plan, 2006 – 2010 (Rahman Idris, 2005). Science education and English literacy development must be core elements in EFL preservice teacher education if economic advancement is a national focus for international engagement.

Science teachers are recognised world wide as a key to science educational reform (Gallagher, 2000; Goodrum, Hackling, & Rennie, 2001), which requires time, resources, and support for ongoing professional development to promote improved learning outcomes. Indeed, teachers generally aim to make a difference to students' lives (Neal, McCray, & Webb-Johnson, 2001),

especially as enhancing students' learning may be linked to effective teaching (Vogt, 2002; Wong, Britton, & Ganser, 2005). The American Association for the Advancement of Science (AAAS, 1993) advocates science education standards that require systemic change involving the development of teachers' perceptions of science teaching. The Australian National Science Standard Committee (2002) also recommends professional knowledge, professional practice, and professional attributes as standards for recognising accomplished teachers of science. Addressing proposed standards will require considerable educational reform, particularly in primary science where such education may not be a priority for teachers (e.g., Goodrum et al., 2001). However, "education reform can succeed only if it is broad and comprehensive, attacking many problems simultaneously. But it cannot succeed at all unless the conditions of teaching and teacher development change" (National Commission, 1996, p. 16).

System requirements for primary science education provide a direction for teaching, and present a framework for regulating the quality of primary science teaching practices (Hudson, Skamp, & Brooks, 2005). If system requirements are necessary for guiding science education reform in primary schools then this should also occur for preservice teacher education. The development of preservice teachers' skills for teaching science requires considerable scaffolding with focused attention on the acquisition of pedagogical knowledge and content knowledge (Abell & Bryan, 1999; Bybee, 1997). Institutions involved in preservice teacher education must provide science education courses with outcomes that are promoted as obtainable goals with the content of such courses aimed at presenting current theories and practices for teaching primary science (Hudson & Ginns, in press).

Although preparation for teaching primary science involves preservice teachers analysing and understanding current theories that underpin a science curriculum and developing adequate pedagogical knowledge and content knowledge (Fleer & Hardy, 2006; Morine-Dershimer & Kent, 1999), EFL preservice teachers have an additional challenge, that is, learning to teach science with links to current education reform measures and learning to teach this subject using EMI (Hudson & Nguyen, submitted). Hence, the Malaysian education system is aiming at addressing simultaneously these two key educational reform measures (i.e., teaching science and teaching science using EMI).

This study explores and describes Malaysian preservice teachers' perceptions about their preparation for learning to teach science using EMI at the conclusion of their first year of a new Bachelor of Education Studies (Primary Science) degree. Fifty preservice primary teachers at a Malaysian institute of education had completed one semester of Malaysian core units that involved Islamic and Asian Civilisation, citizenship studies, strategic and innovative thinking in education, English for academic studies.

The second semester comprised of four units, that is: (1) the development of skills in information and communication technologies; (2) primary curriculum and pedagogy in health and physical education; (3) English for teachers; and, (4) an integrated mathematics and science foundation unit to develop scientific and quantitative literacy. There was also a two-week school-based experience for these preservice teachers to commence forming knowledge of their primary school education system. Even though the first semester was taught in

Bahasa Melayu, the second semester was delivered in English with all lectures, readings, workshops, and assessments conducted in English. This required lecturers and preservice teachers to use English as the target language. It was a requirement that these preservice teachers live on campus in the accommodation provided for the duration of each semester.

Data Collection and Analysis

Open-ended questions aimed to investigate 50 Malaysian preservice teachers' perceptions of their preparation for teaching primary science education using EMI. These questions were a means towards understanding respondents' perspectives (see Polonsky & Waller, 2005). This sample (n=50) represented 100% of the total cohort undertaking a Bachelor of Education Studies (Primary Science) degree in a Malaysian institute of education. The questions focused on their motivation to teach English and the importance of teaching science using EMI; their preparation for teaching English and teaching science using EMI; perceived difficulties for learning how to teach science using EMI; potential benefits for Malaysian primary students' learning of science using EMI; and the impact on learning to teach science for developing the preservice teachers' English-language skills. The questionnaire also included a self-assessment scale numbered 1-10 (lowest to highest) for the preservice teachers to indicate their personal development of English before and after their first year of the degree. In the data analysis, themes and categories were coded for each of the questions, and descriptive statistics were used to quantify the data where appropriate (see Hittleman & Simon, 2002).

Results and Discussion

The open-ended questionnaire was administered in classes at the conclusion of their first year of a Bachelor of Education Studies (Primary Science) degree. The completed responses (88% female; 12% male) provided descriptors of the participants (Malaysian preservice teachers, n=50). All preservice teachers except one had completed the Islamic and Asian Civilisation, citizenship studies, strategic and innovative thinking in education, English for academic studies foundational units. Most of these preservice teachers were 21-22 years of age (88%), and 12% were between 22 and 25 years of age.

Motivation for teaching EFL

Most of these preservice teachers (90%) claimed they decided to teach EFL as it was an international language "to help us face and overcome the problems of globalization. We can't follow the development of the world without improving our language" (Participant 44). Others recognised the global need for using EMI: "We need to expose our country to the world by mastering this language" (Participant 7) and that it is an "important medium of communication" (45). Some indicated the enjoyment of learning English, for example, "I've loved the English subject since I was small" (15) and "learning a language is fun" (30). However, 9% of preservice teachers indicated they had not chosen to teach science using EFL as it was an imposed requirement of their course, that is, "Our education system is giving more attention to English" (Participant 15), "This is compulsory in our institute" (43), and "It is not for me to decide, the 'kementerian' had to decide it early in the year" (34). Nevertheless, these preservice teachers continued with their studies under these requirements.

Access to science knowledge in the English language was noted as substantial for future employment prospects, to illustrate, "Science information or knowledge is in English. If someone does not understand the English language, she or he will feel lost because she/he cannot compete with people around the world" (Participant 38). The Malaysian Government's Vision 2020 was clear with these preservice teachers, case in point: "everyone should learn English to be a Malaysian citizen toward achieving Vision 2020" (23).

Benefits and impact on the preservice teachers' development

The preservice teachers acknowledged the necessity for teaching science using EMI, particularly as science is taught in English in higher education (Participant 1). In addition, "Most of the good revision books are in English and it is very hard to get any Malay version books for this subject" (15). One preservice teacher claimed that science lessons were more interesting as a result of learning English and that it was more suitable to teach science using EMI for the 21st century (6). Others indicated that teaching science using EMI addresses national directives, for instance, "It is the requirement from government. It is also to prepare the work force to excel in globalization internationally" (8) and Malaysian "students will achieve the goal of Vision 2020" (25). Targeting primary students seemed to be relevant as a foundational measure for addressing Vision 2020, to illustrate, "Students will understand science more easily [using English]. Because students at primary school are still at an early stage" (29). Furthermore, "To benefit the primary students the educational system will be more effective. Good for students' future" (49). Another preservice teacher stated that targeting primary students will aid Malaysians to "Master the language, master the world" (50).

Other preservice teachers were coming to terms with how to explain and express themselves in English to primary students studying science education. The following responses in this paragraph represented many of the preservice teachers' thoughts about becoming error free in English grammar and vocabulary. "My vocabulary has improved a lot and I can now write with few grammatical errors" (Participant 15). Even though English is not the "Malaysian's mother tongue" (18) and the historical fact that "During our school days the syllabus was in Malay and we learnt all the [science] terms in Malay" (22), the preservice teachers acknowledged their development of English and science. They also recognised the importance of eliminating errors from their English language in order to teach science effectively: "I'm able to talk more fluently than before and I'm not scared that I'll error when I'm speaking" (22); "I have learnt new words and I'm more sensitive to grammatical errors" (27); "My English has improved as I learn to teach science in English" (6); and, "I started sharpening my mind by learning more about English and science" (9).

These preservice teachers have developed confidence in using English for self study on science topics, that is, "We [are] able to initiate to find and seek for proper explanations of English to teach in science" (50). Confidence building is key to acknowledging the progress of English language for teaching science education, which appears to be the case in this course: "It has improved my confidence to communicate in English" (8). This confidence has lead to more confident instructional usage, for example, "I learned to give English instructions and use the appropriate words in the classroom during this course" (30). These preservice teachers indicated that, as a result of teaching effectively in English, Malaysian primary

students will be able to develop "higher-order thinking skills" (7) and "surf the Internet to get [science] information in English" (8), which will aid the students to "have a good basic education, which will be very useful in their future" (17), including "high school education" (24) so they "can manage themselves in the new environment when they reach university" (36).

A self-assessment scale provided an indication of the preservice teachers' perceptions of their English-language development as a result of units undertaken in this degree. Before commencing the degree the preservice teachers scaled themselves between 2 to 7 (M=4.68, SD=1.20), whereas after completing their first year of study they scaled themselves between 4 to 8 (M=6.38, SD=1.12; Table 1). The increase of 1.70 in the mean score suggested that the participants believed they had improved their English skills after one year of coursework. Yet, it also showed that they recognised they had considerable lengths to go (mean score of 3.62) before perceiving they had achieved optimum English-language development. Even so, they were only one quarter through their degree, hence, achieving a higher self-assessment scale at the end of the four-year degree would be likely.

Table 1:
Preservice Teachers' Self-Assessment of their English-language Development

Scale	Before	After
1	0	0
2	2.0	0
3	14.0	0
4	30.0	6.0
5	30.0	18.0
6	16.0	22.0
7	8.0	40.0
8	0	14.0
9	0	0
10	0	0

*Valid percentage of preservice teachers indicating their perceived level of English development as a result of the first year of a Bachelor of Education Studies degree.

Difficulties for learning to teach science using EMI

The main difficulties encountered by these preservice teachers for learning how to teach science using EMI were about having time to learn English with the associated science terminology and the current Western culture: "I am used to speaking in Chinese with my friends. I have my own language at home and I have not much free time to read in English everyday" (Participant 2). This type of comment was indicative of the majority of comments with a further 46% claiming that understanding or "memorising science terms" presented the biggest barrier for learning how to teach science using EMI. In addition, the preservice teachers noted that lecturers also have had to adjust for teaching science content in English, which they previously taught in Bahasa Melayu. This presented another level of difficulty, for instance, "The teacher may not be used to science terms in English as they have been teaching Malay for a long time. Moreover, some teachers may face difficulty in speaking English as it is not their mother tongue" (Participant 1). Similarly, "Students do not

understand well. Teachers can not explain well in English but explain well in their mother tongue" (49). So the preservice teachers have to overcome their own English-language barrier while some lecturers also grapple with teaching a subject they had taught only in Bahasa Melayu. Those teachers who were strong with English faced the difficulty of getting across the language to their students, "The foundation of English language for students and teachers is not good. Some teachers are good in English but students can't understand them" (44).

Possible solutions for learning to teach English and for teaching science using EMI

These preservice teachers indicated various solutions for preparing themselves to teach science using EMI. Seventy-two percent indicated that reading different texts had aided their preparation for teaching science using EMI. These texts included English articles, newspapers, novels, magazines, and any available English literature, for example, "I read the bible which is an English version everyday. I jot down the words that I can't understand and read them when I'm free" (Participant 2). There was overwhelming acknowledgement that vocabulary, grammar, and pronunciation were paramount for developing their language. Participant 22 claimed the need to "Enrich my vocabulary. To learn the correct pronunciation. Pamper myself with grammar". "Learning to use the dictionary appropriately and making a draft and ask my friends to check my grammar and structure before pass up my assignment" (33) were noted as ways to improve vocabulary and grammar. Indeed, peer-assisted learning by reviewing another's assessment pieces was proving to be a valuable method indicated by six participants for enhancing their English competency, to illustrate, "I ask friends to correct my English and find where I have made a mistake" (37).

The majority of these preservice teachers perceived their preparation for teaching science using EMI involved learning scientific vocabulary on specific topics and the associated scientific names, for example, "I can always refer to the scientific names of the science for example the key words and their meaning through the dictionary" (Participant 12). Using an English-based science dictionary was noted as a way forward. However, some referred their preparation for teaching science using EMI was directly related to learning English without reference to scientific terms. "I must read a lot of English materials and try to speak in English most of the time. I also can refer to people who are better than me if I have a problem regarding this language" (20). Participant 40 advocated severe measures by trying to "Avoid the use of Malay terms and try to ask friends or lecturers if [we] do not the scientific term" (40).

Although some considered discussing with friends the science English terms and reading lecture notes in English (Participant 33), two preservice teachers claimed that knowing the science terms was not sufficient enough, to illustrate, "[we] should know and learn term of science in English but [we] also must know how to elaborate the knowledge using the word/term in science" (38). Nevertheless, there appeared to be some consensus about learning the science terms in English before involvement in lectures on the topic in order to develop a deeper understanding of the content: "Introduce the terms by searching the meaning first is the best way to understand the content later" (45).

Other supportive suggestions for English-language development included conversing frequently with friends "such as group discussion among friends" (Participant 28) and "trying to speak more English with my course mates" (37). Participant 8 claimed success in learning English by designating full English speaking days, to illustrate, "I have put effort into improving my competency in English. My friends and I decided Wednesday as English day and speak fully in English on that day. Quite successful". Undoubtedly, speaking English everyday has a role at the institutes outside the immediate coursework, "Try to learn everyday. If there is a change try to use it in our daily lives" (29). Participant 2 also stated that she prepares herself by communicating in English using electronic methods: "I try to speak with my friends in English and chat with my friends in the internet by English." These preservice teachers perceived other forms of preparation for EFL teaching that involved listening to the radio (Participants 3, 9, 30, 40, 49), reading grammar books (5), checking meanings with a dictionary (17, 21), watching English movies (24, 27, 50), listening to English songs (34), and writing frequently in English (25, 48) including email, Internet chatting and short message service (i.e., sms from cell phones; 36). These multi-media techniques appeared to assist the preservice teachers' language development.

Summary and Conclusion

The preservice teachers indicated in this study that social interaction using English appeared to be a successful way forward for developing the language, which is advocated as a key goal in TESOL education (TESOL, 1997). These preservice teachers claimed that coursework delivered in English, including English-based assessments, allowed them to more effectively construct academic knowledge in the target language. Learning strategies such as Internet chatting and English-only days provided means for enhancing communicative competence. In addition, these preservice teachers needed to understand key scientific terms before a lecture commences so there is greater familiarity when provided new information around such terms. The preservice teachers suggested a wider range of teaching strategies (e.g., listening to the radio, reading grammar books, checking meanings with a dictionary, watching English movies, listening to English songs, and writing frequently in English, including email and short message service) that aided towards facilitating their English skills. Educators need to listen to preservice teachers' testaments of success and incorporate or facilitate such practices in their coursework.

Malaysia is at a critical point of education reform and interactions with other education systems may aid in transforming its own education system. To meet this educational reform will require teaching primary science using EMI. This means targeting primary science education concepts and English concepts simultaneously if the Vision 2020 goal is to be reached. Preservice teacher education course construction will be paramount for injecting new educational ideas into the system. Indeed, the education of preservice EFL teachers must be a focus of attention in an effort to obtain quality EFL teaching (Haley & Rentz, 2002; Larsen-Freeman, 2000) and gain access to the world's knowledge base on science. Investigating preservice teacher development during this formative period can aid in refining programs to further enhance such development. The preservice teachers in this study provided information about their preparation for teaching science using EMI that can guide educators' construction of coursework.

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